Canadian Institute for International Peace and Security

Institut canadien pour la paix et la sécurité internationales

WORKING PAPER 33

THE NORAD RENEWAL ISSUE

Report of the Special Panel to the Sub-committee of the House of Commons Standing Committee on External Affairs and International Trade considering the question of renewing in May 1991 the North American Aerospace Defence Agreement

March 1991

91-04523/

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ISBN 0-662-694-X
CC 293-5/33E

PREFACE

Working Papers, the results of research work in progress or a summary of a conference are regarded by the Institute to be of immediate value for distribution in limited numbers -- mostly to specialists in the field. Unlike all other Institute publications, these papers are published only in the original language.

The opinions contained in the papers are those of the participants in the panel and do not necessarily represent the views of the Institute and its Board of Directors.

During October 1990, the House of Commons Standing Committee on External Affairs and International Trade established a Sub-committee to enquire into the issue of renewal of the North American Aerospace Defence Agreement (NORAD). This Sub-committee met on 25 October and launched a three-stage process of enquiry, involving: engaging a special Panel of experts to report to it on the issue; public hearings with other witnesses; and the eventual preparation of recommendations from the Sub-committee to the main committee.

The present paper is the report to the Sub-committee by the special Panel of experts. It was discussed at a meeting of the Sub-committee with the Panel on 29 November 1990, and finalized shortly afterwards taking into account the comments of the Members.

The report consists of seven papers written by four authors, as indicated in the table of Contents. Chapters 2 to 6 are individual contributions that are not necessarily supported in their entirety by all the Panel members, even though they have carefully reviewed and discussed them together. The final section, containing the Conclusion, Options and Findings, is supported by the Panel as a whole.

The Panel consists of David Cox, Professor, Department of Political Studies, Queen's University; Roger Hill (Chair), Senior Research Fellow, Canadian Institute for International Peace and Security; George Lindsey, Consultant, former Chief, Operational Research and Analysis Establishment, Department of National Defence; and Tariq Rauf, Senior Research Associate, Canadian Centre for Arms Control and Disarmament.

Acknowledgements

The Panel is grateful to Gregory Wirick and his colleagues at the Parliamentary Centre for Foreign Affairs and Foreign Trade for editorial comment, liaison and other assistance. It is also grateful to the staff of the Canadian Institute for International Peace and Security for arranging the meetings convened at the Institute's offices, and for other help.

Roger Hill
Panel Chair

CONDENSÉ

En octobre 1990, le Comité permanent des affaires extérieures et du commerce extérieur (Chambre des communes) a mis sur pied un sous-comité qu'il a chargé d'examiner la question de la reconduction de l'Accord sur la défense aérospatiale du continent nord-américain (NORAD). Le sous-comité s'est réuni le 25 octobre et a amorcé une étude en trois étapes, à savoir l'embauche d'un groupe spécial d'experts qui a, depuis, présenté un rapport sur la question; la tenue d'audiences publiques avec la participation d'autres témoins; et la rédaction éventuelle, par le sous-comité, de recommandations destinées au CPAECE.

Le présent document est le rapport présenté au sous-comité par le groupe spécial d'experts. Il a fait l'objet de discussions lors d'une réunion que le sous-comité a tenue avec le groupe le 29 novembre 1990, et les auteurs y ont mis la dernière main peu après, en prenant en compte les observations des députés membres du sous-comité.

Le rapport comprend sept mémoires rédigés par quatre auteurs, comme en fait foi la Table des matières. Les chapitres 2 à 6 représentent des contributions individuelles qui ne font pas nécessairement l'assentiment de tous les membres du groupe, même si ceux-ci en ont discuté ensemble et les ont examinés attentivement. En revanche, tout le groupe a sanctionné la dernière partie, qui contient la Conclusion, les Options et les Constatations.

Le groupe comprend David Cox, professeur au département de sciences politiques de l'Université Queen's; Roger Hill (président), chargé de recherche principal à l'Institut canadien pour la paix et la sécurité internationales; George Lindsey, expert-conseil, autrefois chef du Centre d'analyse et de recherche opérationnelle au ministère de la Défense nationale; et Tariq Rauf, chercheur associé principal au Centre canadien pour le contrôle des armements et le désarmement.

L'analyse commence avec un bref aperçu des concepts sous-jacents à la question du renouvellement de l'Accord du NORAD, en mettant l'accent sur des aspects afférents au principe de la dissuasion.

Le chapitre 2 s'arrête à l'évolution actuelle de la conjoncture stratégique en Union soviétique et à ses conséquences possibles. Le chapitre 3 examine les tendances de la défense continentale aux États-Unis et leurs incidences probables. Dans le chapitre suivant, les auteurs s'interrogent sur les effets que pourraient avoir sur l'équilibre militaire central les accords de limitation des armements stratégiques.

La question spéciale de la surveillance aérospatiale fait l'objet du chapitre 5. Vient ensuite une analyse des intérêts nationaux du Canada et des États-Unis ainsi qu'un examen des mécanismes de consultation et d'autres relations existant dans le domaine de la défense aérospatiale. Enfin, le lecteur trouve un chapitre résumant les principaux points abordés dans le document, et présentant un relevé des options formulées et des constatations clefs faites à la faveur des travaux.

Les auteurs n'avaient pas pour mandat d'examiner chaque question particulière se rapportant à la reconduction de l'Accord du NORAD. Ils ont plutôt essayé de se concentrer sur les aspects essentiels, en exprimant leurs points de vue personnels dans les chapitres 2 à 6, puis en présentant une déclaration commune dans le chapitre 7. Ils se sont attachés à des questions telles que les suivantes : quels grands changements ayant actuellement cours dans le monde risquent d'influer sur le débat concernant la reconduction de l'Accord ? À quelle vitesse se produisent-ils ? Vu la conjoncture, faut-il renouveler l'Accord du NORAD ou non ? Dans l'affirmative, pour combien de temps ? Et devrait-on en maintenir, élargir ou restreindre la portée ? S'il est effectivement reconduit, doit-on faire d'autres déclarations ou entreprendre d'autres démarches relativement à la défense aérospatiale du continent ou aux questions connexes ?

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1. OVERVIEW

Introduction

The world today is a scene of extraordinary change. A time of progress has dawned in East-West relations that is yielding remarkable advances on some of the most thorny of international issues, and there are now great hopes of moving on to a new era of co-operation and common security. Naturally, though, there are enduring concerns about security in the Northern hemisphere, just as difficult problems persist in the South and at the global level. This is a time for fresh thinking and for new initiatives, but also for careful responses that draw where they can on well-tried knowledge and proven method.

Canada has also entered a new phase of its history. At the international level, it has joined in a free trade agreement with the United States, participated in efforts to reformulate security relationships in Europe, and dispatched naval vessels, fighter aircraft and other forces to the Persian Gulf. For the first time in a generation, Canadians are facing the possibility of military action, in support of the United Nations and of international order.

This is the context in which Canada again faces the question of NORAD renewal. Parliament and government have to consider the state of the international system and decide whether joint aerospace defence of the continent with the United States is still required for the coming period. They have to review Canada's goals and requirements in this field and determine whether the North American Aerospace Defence agreement is the best way of pursuing them. Modifications in the accord itself or in the command structures, decision-making procedures, and consultative arrangements that support it might also be made if they seem warranted.

When NORAD was last renewed in 1986, Canada seemed to many people to be caught in perpetuity in the midst of a strategic confrontation between the Soviet Union

and the United States. It had been more than half a century since Senator Dandurand had felt able to claim that Canadians lived in a "fire-proof house, far from inflammable materials." Almost three decades had elapsed since Canada and the United States had entered into the 1958 agreement for the co-ordinated air defence of the continent. Canada seemed forever placed "in the path of nuclear missiles"[1]; and the House of Commons Standing Committee on External Affairs and National Defence accordingly recommended, in a report supported by a majority of its members, that the NORAD agreement should be renewed "for a period of five years with no substantial modifications in the thrust of the document."[2]

Has the situation changed significantly since 1986? Should it be seen differently? What are Canada's principal requirements in this field and what are the best ways of pursuing them? These are the main issues addressed in the present report.

The analysis begins with a brief look at some of the concepts underlying the issue of NORAD renewal, focussing on questions related to the principle of deterrence.

Chapter 2 considers current strategic developments in the Soviet Union and their possible implications. Chapter 3 reviews trends in continental defence in the United States and considers their possible impacts. Chapter 4 discusses the potential effects of strategic arms control agreements upon the central military balance.

The special issue of aerospace surveillance is examined in Chapter 5. This is followed by an enquiry into Canadian and US national interests and consultative and other relations in the aerospace defence field. Finally, there is a chapter noting the main points made in the paper, and completing the study with the presentation of a set of options and a body of principal findings.

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[1] See House of Commons, The Standing Committee on External Affairs and National Defence, Fourth Report, *Canada-U.S. Defence Co-operation and the 1986 Renewal of the NORAD Agreement*, Chairman's Foreword, p. xi, 14 February 1986.

[2] *Ibid.*, p. 78.

This report is not intended to cover every special issue impinging on the question of NORAD renewal. Instead, the authors have tried to concentrate on the essentials, giving their individual views in Chapters 2 to 6 and then providing a collective statement in Chapter 7. They have focussed on the following kinds of issues: what are the main changes now underway in the world that may affect the NORAD renewal issue? How rapidly are they taking place? In light of these developments, should NORAD be renewed or not? If it were to be renewed, how long should the new mandate be? If renewed, should its scope be maintained, broadened or narrowed? And if renewed, should any supplementary statements be made or initiatives taken on continental aerospace defence or related issues?

Fundamental Concepts

A key issue relating to the future of NORAD is the potential for far-reaching change in the Soviet-American strategic relationship. For much of the last three decades this relationship has been based on the concept of deterrence, but recently questions have been raised about its continued validity and relevance. Some analysts question whether deterrence ever worked as it is supposed to have done; others believe that it may be replaced in due course by doctrines of strategic defence and protection; and a third group envisages it giving way to far-reaching arms control and disarmament measures and new approaches based on the pursuit of co-operation and common security.

Strategic nuclear deterrence was embraced by the United States once the Soviet Union had acquired long-range bomber aircraft with intercontinental range as well as nuclear fission weapons that could be delivered by those bombers. The reliance on deterrence rather than active defence became even stronger when thermonuclear fusion bombs and nuclear-armed ballistic missiles with intercontinental range were added to the two sides' arsenals. By then it was obvious that nothing could prevent destruction at totally unacceptable levels once a full-scale strategic attack was launched and delivered. Hence

security was founded on prevention of attack through deterrence, rather than on the pursuit of effective active defence aimed at destroying incoming bombers or missiles.

Since the 1950s, a great deal has been done to make deterrence as stable as possible. At one time, it was possible to imagine a surprise attack on the opponent's strategic systems that could eliminate the capacity to retaliate by destroying all bombers on the ground. That was still conceivable at the time the first ICBMs (Inter-continental Ballistic Missiles) were deployed, since they were soft structures above the ground, very vulnerable to blast, and requiring many hours of preparation before they could be launched.

This situation was extremely dangerous. It gave the advantage to the side which struck first, and it provided a logical incentive for both to set their retaliatory forces for a "hair trigger response". Moreover, if confusing or conflicting information was received at a time of crisis that gave false indications of an attack in progress, then there would be a strong temptation to launch the retaliatory forces first while they were still intact. There could have been a war by mistake.

Enormous and very costly steps were taken to correct this frightening instability. American bomber aircraft were dispersed and arrangements were made to keep some of the force in the air at all times. ICBMs were based in underground silos and given solid-state rocket motors that greatly reduced preparation time. A large proportion of the retaliatory force was put under water in nuclear-powered submarines armed with SLBMs (Submarine-Launched Ballistic Missiles). And the deterrent forces were made more robust by so adding to the numbers of strategic nuclear weapons that no conceivable attack could destroy enough of them to make unacceptable retaliation impossible. The USSR took comparable steps, and strategic deterrence became mutual and much more stable. Canada, for its part, contributed to this development mainly through NORAD, by helping to ensure early warning of possible strategic attack on North America while also maintaining some residual active defence capability against manned bombers and their missiles.

In the last few years, scholars of international relations have begun to take a closer look at the concept of deterrence. Noting the dearth of empirical data about the success or failure of deterrence in a sufficiently wide range of specific cases, some have argued that it cannot be proven that deterrence has worked effectively to prevent World War Three. However, the reverse is also true: it cannot be disproved. The United States and the Soviet Union, for their part, continue to rely on deterrence as the basic concept underlying their strategic interrelationship.[3]

Another potential challenge to deterrence came from the Strategic Defense Initiative (SDI) launched by President Reagan in 1983. As originally conceived by him, this was essentially a long-term research programme intended to see whether systems might be developed that would permit the United States to shift from dependence on the threat of retaliation to reliance on active defences. Had the research and development programme shown this to be technically feasible, SDI could have led to the construction of a vast panoply of layered defences for the United States and possibly some participating allies, and could have replaced deterrence by reliance on an umbrella of strategic defence systems. However, such ambitious conceptions have now given way to more modest versions aimed not at the replacement of deterrence but at its enhancement through the construction of some limited defences for deterrent forces. The SDI programme is now much smaller than originally envisaged. Any deployments before the end of this decade are likely to be no more than local defences for a few key targets in the United States, and even that is very doubtful in the prevailing budgetary and political climate.

The prospects for strategic arms control need to be examined carefully. Even reductions of several thousand warheads, however, by stages, if that occurs, should be

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[3] For one excellent contribution to this field of enquiry into deterrence, see Richard Ned Lebow and Janice Gross Stein, *When Does Deterrence Succeed and How Do We Know?*, Ottawa, Canadian Institute for International Peace and Security, Occasional Paper No. 8, February 1990.

measured against the estimate that only 50 to 100 warheads would be needed to destroy effectively the cities of the United States and Canada, or those of the USSR. Deterrence will still be necessary as long as that frightful capability remains in place.

Once cuts reduce weapons below certain minimum levels, however, it becomes less certain that an adequate retaliatory force would survive a surprise attack. And if the command and control system is vulnerable, the number of weapons required to cripple it will be small. It is only when one goes beyond such a state of affairs, to a world of massively reduced nuclear forces where the residual numbers would be very small indeed and also rigorously controlled by an arms control régime, that a tolerable international system could be based on something other than deterrence.

From a specifically Canadian point of view, the early agreements under START are likely to increase reliance on deterrence rather than lessen it. They seem likely to increase the proportion, and possibly even the total size, of the Soviet strategic force that resides in bomber aircraft and cruise missiles, so that the need to rely on early warning and the US capacity to retaliate will be at least as strong as now.

The other possibility for moving away from deterrence lies in the hope for fundamental change in political relations between the United States and the Soviet Union and among their various allies and associates. If the two sides continue to move away from confrontation and maintain a course towards greater co-operation and the eventual pursuit of common security, their use of nuclear weapons against any country in Europe or North America may become completely unthinkable. Relations would no longer be based on a nuclear stand-off of any kind, but on the pursuit of harmony and a shared destiny where nations and individuals could live and work peacefully together.

In such circumstances, the great stocks of strategic nuclear weapons on the two sides could become irrelevant. They would need to be carefully maintained and managed until they could be reduced under agreed arrangements, but they would no longer be seen as even a potential threat to security.

This must be the fervent wish of anyone observing East-West relations and developments in the Soviet Union and Central and Eastern Europe today. The recent Paris Summit and the signing of a first agreement on Conventional Armed Forces in Europe (CFE) provide reason for hope.

The conventional forces of East and West are now undergoing massive reductions as a result of unilateral cuts, bilateral agreements, the Two-Plus-Four negotiations on the future of Germany, and the CFE process. By the mid-1990s, Europe will probably no longer be the focal point for military confrontation between two competing alliances. Instead, it may become a catalyst that draws together the European Community, the Soviet Union, the United States, Canada, and other associated states in the search for security through co-operation. However, whether this in fact takes place remains to be seen.

Certainly, levels of strategic armaments still remain high on the two sides and will take time to cut back. Nor is everything that is taking place in the world today reassuring about the future. In addition to the Persian Gulf crisis and serious difficulties in Central and Eastern Europe, the Soviet Union in particular faces enormous constitutional, economic, ethnic and other problems. No one can be certain where events in that country will lead over the next few years. For the time being, deterrence will remain the foundation on which our security rests.

2. SOVIET STRATEGIC DEVELOPMENTS AND THEIR IMPLICATIONS

Introduction

A revolution is taking place in the Soviet Union. Whether the transition to a new system is made peacefully or violently remains to be seen. What is certain, however, is that enough structural and political changes have taken place under the leadership of

Mikhail Gorbachev that the system can never return to its former state. The monopoly of power of the Communist Party of the Soviet Union (CPSU) has been broken, and it would not come as a surprise if, over some period of time, the CPSU were to be replaced in power by an alternative political grouping.

The Soviet Union is in the midst of its most significant crisis -- one that relates to the very basics of life -- and compared to this crisis, questions of foreign policy and even military confrontation pale in importance. According to the veteran US diplomat George Kennan, while the USSR never at any time in the past planned a deliberate attack on the West, the probability that it would contemplate doing so now or at some future date is extremely low. Indeed, the very question has become largely irrelevant. At a time when the USSR is threatened with a disintegration of the union, it is highly unlikely that it would seek a military confrontation. Moreover, traditionally, the Soviet military has not played much of a role in politics, particularly not during the Communist period, and it is expected to be even less relevant in determining the future course of events.

The Soviets have ended the Cold War, torn down the Iron Curtain, and through the Treaty on reducing Conventional Armed Forces in Europe (CFE), accepted asymmetrical cuts to equal levels with NATO. Together with the 1987 INF Treaty, and the unilateral withdrawal of Soviet troops underway from Eastern Europe, the USSR has transformed the East-West political and strategic landscape. And, a strategic arms reduction treaty (START) is expected to be signed sometime in early 1991.

Under Gorbachev, the Soviet Union has moved to decrease the number of non-strategic weapons that could be used or lend themselves mostly to offensive purposes, and to increase the proportion of those that are defensive. And, to reassure the West of their intentions, the Soviets have accepted the principles of openness and transparency in military affairs in relation to negotiated, verifiable arms control agreements; they have significantly cut back the deployment of projection forces; and have curtailed intercontinental training missions and anti-shipping operations by strategic bombers.

Despite the far-reaching reforms underway in the Soviet Union, there is some concern that Gorbachev may not survive for long, given ever increasing domestic economic and political problems, and that his successors may return to hard-line reactionary policies, or that he might be displaced in a military coup. Against these arguments, it should be remembered that Gorbachev's reforms have fundamentally transformed the Soviet Union, since there is virtually no support for a return to the harsh Stalinist or stagnant Brezhnevian past, and negligible opposition to his foreign policies. The majority of the Soviet officer corps remains convinced of the need for political and economic reforms, including reductions in military expenditures. Finally, there is more than ample evidence to suggest that, whether or not Gorbachev survives, the majority of his reforms are here to stay.

Changing Defence Priorities in the USSR

From the very outset, Gorbachev has argued that Soviet national security has been overly reliant on military power at the expense of political and economic development. Despite this, the broad-based military modernization programme initiated in Brezhnev's time was not altered in Gorbachev's first three years in office. By 1988, however, it became obvious that Gorbachev had concluded that the USSR could not sustain this level of military buildup. In December 1988 and in January 1989, he announced unilateral cuts in conventional ground and air forces, as well as reductions in defence spending to be phased in over a three-year period.

On 30 May 1989, Gorbachev noted that defence spending in 1989 would amount to 77.3 billion roubles, and last December the Soviets claimed that military expenditures would decrease by more than eight percent to about 70.9 billion roubles in 1990. These figures are substantially larger than the roughly 20 billion roubles per year the Soviets had claimed since the mid-1960s, but still only about half the level of spending estimated by US intelligence agencies. These US agencies, as well as some Soviet sources, attribute the

continued Soviet understatement of defence spending to the exclusion of certain defence programmes and forces from the budget, and the underpricing of military equipment procured by the Ministry of Defence. While there is some debate over Soviet figures on overall military expenditure, it is clear that defence spending in the USSR is declining.

US intelligence agencies estimate that Gorbachev's promised cuts have resulted in a four to five percent real decline in Soviet defence spending in 1989, and weapons procurement declined by about six to seven percent last year because of cutbacks on several weapon production lines. US intelligence agencies estimated Soviet defence spending in 1989 to total around 112 billion roubles, of which 40 billion roubles was on weapons procurement.

Soviet cutbacks have come primarily in general purpose forces, especially in ground forces equipment. Estimates show military manpower to have dropped by 200,000 last year, while procurement for strategic systems declined by about three percent in 1989. US intelligence agencies believe that further reductions in Soviet military spending are almost certain in 1990 and 1991, and that the trend line is clearly on the decline. Moscow continues to reduce and restructure its armed forces, and the economic urgency of defence reductions shows no signs of diminishing. Further, long-term cuts in overall procurement and stocks of non-strategic weapons -- and especially military manpower -- will likely be substantial, as Soviet force levels are constrained under the CFE Treaty.

Recently, there has been much talk in the USSR about plans to convert defence industries to the production of civilian goods. Definitions of the term "conversion" are hard to come by, and even more difficult to operationalize. In general, for the Soviets, conversion implies the actual production of civilian goods and products at defence-industrial enterprises. The Soviets claim that over 400 defence plants and 200 research establishments have increased production for the civilian sector. Visible significant increases in the production of civilian products by the defence industrial sector are as yet difficult to quantify. According to the State Planning Committee (Gosplan), however,

the defence industry's civilian production will double to 110 billion roubles per year between 1988 and 1995.

Strategic Modernization

While Soviet conventional and naval forces have been cut back under Gorbachev, strategic offensive force modernization has continued largely unabated. New strategic weapons systems continue to come on line, as older systems are retired. As well, cost savings resulting from arms control will be achieved primarily by cutting back conventional, or non-strategic forces. Strategic nuclear forces, in both the US and the USSR, account for a small share of overall defence spending. In general, strategic force procurements are stretched out over a longer time period and are usually difficult to stop in mid-stream. Further, it seems that Soviet strategic modernization is being geared toward optimizing their force structure under START,[4] and in response to lowered levels of defence spending. In parallel with the US, post-START Soviet strategic weapons will be more accurate, survivable, and reliable.

Last year the Soviets produced roughly the same number of new strategic offensive missile systems as in 1988, totalling 140 Inter-continental Ballistic Missiles (ICBMs), 100 Submarine-launched Ballistic Missiles (SLBMs), 40 bombers, 2 ballistic-missile submarines (SSBNs), 7 general purpose submarines, and about 200 long-range nuclear-armed air-launched cruise missiles (ALCMs). According to the US Defense Department, Soviet output of TU-95H/TU-142 (*Bear*) bombers declined in 1989, reflecting a lower production level. Output of the TU-22M (*Backfire*) medium-bomber remained essentially constant, while that of the new strategic bomber, TU-160 (*Blackjack*), continued

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[4] Soviet retirements under START could include: SS-11, SS-13, SS-17, SS-18, and SS-19 ICBMs; SS-N-6, SS-N-8, SS-N-17, and SS-N-18 SLBMs; several thousand associated ballistic missile warheads; *Hotel*-, *Yankee*-, and *Delta*-class SSBNs, and TU-95 A/B/C bombers. Overall, the Soviets would have to retire a greater number of both old and new weapon systems than the US.

at a low rate. Production of the *Typhoon*-class fleet ballistic missile submarines (SSBN) apparently was halted with the production of the sixth and most recent boat.

According to the US Defense Department, by the end of the 1990s, post-START Soviet strategic forces will change significantly in terms of their composition. The proportion of mobile Inter-continental Ballistic Missile launchers will likely increase to about two-thirds of the total ICBM force, thus giving the USSR a more survivable force. Heavy ICBMs[5] will continue to carry about half the warheads, despite reductions in launcher numbers to 154. The size of the ballistic missile-carrying submarine force will decline by nearly one-third, and the number of SLBM warheads will decrease slightly. The operational bomber force is likely to increase to about 130 *Bear* bombers carrying cruise missiles (from the present 90), and in excess of 60 *Blackjack* bombers carrying gravity bombs and short-range attack missiles (SRAMs). In accordance with US wishes, as expressed in the framework of START, the percentage of Soviet ICBM and SLBM launchers within the Soviet strategic nuclear forces will decline somewhat under START, while the percentage of bombers will increase. As well, the percentage of warheads carried on Soviet bombers will rise relative to ICBMs and SLBMs.

A post-START Soviet bomber force will reflect the current modernization programme, as obsolete bombers are replaced with new ALCM-carrying aircraft. The prominence of ALCM-equipped bombers will give the Soviet bomber force an enhanced strategic strike capability. It must be stated here that the US favours the Soviets concentrating more deliverable warheads on their bombers, in contrast to deploying them on ballistic missiles. According to one estimate, a post-START Soviet bomber force could grow to 200 bombers with some 3,400 warheads, and still be counted as only 1,100 bomber weapons. (The US, however, would be in a far better position to exploit the START bomber-counting rule.)

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[5] Intercontinental ballistic missiles capable of carrying more than six warheads/re-entry vehicles are defined as "heavy" missiles in the draft text of the US-USSR strategic arms reduction treaty (START), currently under negotiation.

As part of their on-going cruise missile modernization programme, the Soviets are likely to integrate advanced technologies such as lower radar cross-sections, enhanced ranges, and conventional munitions into their new long-range nuclear-armed cruise missiles. Strategic ALCMs include the AS-15 (deployed) and AS-X-19 (under development), and SLCMs include SS-N-21 (deployed) and SS-NX-24 (under development). The AS-X-19 may reach initial operating capability in the early 1990s.

In sum, modernization of the Soviet bomber force, together with the emerging hard-target-kill capability of the SLBM force and the increasing number of mobile ICBMs, will provide the Soviets with a more balanced and survivable strategic nuclear force structure -- much like that of the US. The direction and pace of Soviet strategic modernization would be strongly influenced by a US decision to deploy any strategic defence system.

The Soviets are also developing and modernizing their existing strategic defence system, allowed under the 1972 Anti-Ballistic Missile (ABM) Treaty. Continuing Soviet strategic air defence improvements will likely degrade the ability of the US B-52 and B-1B strategic bomber force to penetrate to their targets. Although the new US B-2 bomber is likely to recapture this penetration capability, to date the US Congress has approved funding for the production of only 15 B-2 bombers. Soviet strategic surface-to-air missiles (SAM) have remained roughly constant in numbers since 1985, but their capability has increased with the deployment of the SA-10 missile. Approximately 25 percent of the Soviet's 8,650 SAM launchers are SA-10s. The US, in contrast, maintains no strategic SAMs.

Soviet Aviation of Air Defence (APVO) has also been improved, with the deployment of modern fourth-generation fighter-interceptors. While the procurement of AWACS aircraft has slowed to only one in 1989, AWACS together with APVO interceptors can project homeland air defences well beyond Soviet borders.

Trends in Soviet Strategy

Soviet strategic offensive forces and nuclear policy are in a state of flux, but thus far the changes have been less dramatic than those in other areas of Soviet policy. Soviet military doctrine now asserts that a future general nuclear war would develop out of a period of major international tension and crisis. Although the Soviets have repeatedly declared since 1982 that they will not be the first to use nuclear weapons under any circumstances, their strategic forces are structured and possess the capability to conduct a first strike, if required.

Two significant trends can be identified in Soviet military thought that may shape their strategy into the 21st century. One trend is a reduction in Soviet conventional and theatre nuclear forces consistent with a doctrine of "reasonable sufficiency." It seems clear that they have abandoned conventional and theatre nuclear options that cost them billions of roubles to acquire in the 1970s and 1980s. An arms control trend, stemming from the concept of "reasonable sufficiency" and "defensive structures", will severely handicap the USSR in future options for fighting and winning large-scale conventional and theatre-nuclear wars.

On the other hand, the Soviets seem determined to retain their strategic nuclear options in a post-START world, as they seem to think that the strategic nuclear sphere will be the key arena of military competition in the future. The Soviets seem to show a greater commitment to an offensive counterforce structure, than was prevalent prior to the period of "reasonable sufficiency." A continuing commitment to modernized strategic nuclear forces is reinforced by a trend toward militarization of space. The Soviets appear to perceive space as the key to strategic nuclear options and to superpower status in the 21st century.

At the same time, however, the Soviets seem willing to soften the military competition in space through arms control. Some Soviet military thinkers have begun to suggest, tentatively, that mutual anti-ballistic missile deployments of "thin defences" under

certain circumstances -- i.e., deep cuts in strategic offensive forces -- might be preferable to the current prohibitions of the ABM Treaty, especially to protect against third parties, given the trends in ballistic missile proliferation in the Third World. In other words, "defensive deterrence" founded on "powerful shields" and "shortened swords." However, "powerful shields", for the Soviets, do not mean US SDI-type systems, but "thin defences"; while "shortened swords" refer to radical reductions in strategic offensive forces and replacing MIRVed systems with single-warhead systems. Whether this translates into an official Soviet position remains to be seen.

In sum, despite improved relations with the US, potential arms control agreements, and the near dissolution of the Warsaw Treaty Organization, both the Soviet Union and the United States are continuing to streamline and improve their offensive strategic nuclear forces. While the pace of Soviet modernization is not as rapid as in the 1970s and early 1980s, it is clear that the Soviets are not prepared to yield the advantage in strategic offensive forces to the US, and will continue to maintain "parity".

At the same time, it must be noted that dramatic improvements in US-USSR bilateral relations, on-going reforms in the political and economic structures of the USSR, together with other factors, such as changes in Soviet foreign and defence policies, have resulted in virtually removing the threat of war from the East-West agenda. In recognition of the sweeping changes already implemented in Soviet military strategy and posture, the United States has grounded its "Looking Glass" flights -- whereby strategic command and control aircraft were constantly airborne on a 24-hour basis, in order to provide a redundant national command authority in the event of a surprise attack on the US. In general, US intelligence agencies have significantly downgraded the potential military threat from the Soviet Union.

The reduced threat perceptions on the US side are a direct result of perceived changes in Soviet *intentions*, since no reductions in Soviet strategic nuclear *capabilities* have taken place, thus far. This changed situation is indicative of the fact that perceived intentions and demonstrated policy reforms can result in lowered overall strategic threat

perceptions, and greater confidence in the politico-military intentions of the other side, even if strategic arms reductions are only in the process of negotiation.

Soviet nuclear policy[6] and deployments can best be assessed by demarcating key milestones in the growth and increasing sophistication of the Soviet nuclear arsenal. The latest phase, beginning in the mid-1980s, saw the generational transition in Soviet leadership and the accession to power of Gorbachev. As a result, a major re-evaluation of all aspects of Soviet life, including the military, has taken place and continues to this day. Gorbachev's numerous arms control proposals include: a unilateral moratorium on nuclear testing, accepting asymmetrical reductions in INF and conventional forces, strategic arms reduction, acceptance of intrusive on-site inspection (to the degree where even the US has backed off on occasion), regional arms control and CSBMs (confidence- and security-building measures) in the Arctic and the Pacific, and the elimination of nuclear weapons by the year 2000. Also, a new doctrine of "military equality, or equal security for all" -- based on the assumption that not every military advance by the US need be matched, so long as "reasonably sufficient" military forces are maintained -- has been advanced and is being implemented.

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[6] The USSR, like the US, has essentially four kinds of nuclear weapon policies: declaratory, employment, deployment, and acquisition.

a) Soviet *declaratory* policy is embodied in the collection of public statements by politico-military officials that addresses why the Soviets possess nuclear weapons, how they might use them, and how the dangers of living with nuclear weapons might be lessened.

b) Soviet *employment* policy lays down goals for and determines how the USSR would actually use its nuclear weapons to fight a war. Employment policy constitutes the real Soviet strategic integrated operational plan, and is known to only a few officials. It may be either somewhat congruent with or quite different from declaratory policy.

c) *Deployment* policy reflects the location and disposition of Soviet strategic forces.

d) *Acquisition* policy addresses how complex, competing bureaucracies allocate resources to military research, development, testing and production of nuclear weapon systems.

The Future

It is as yet too early to conclude how Gorbachev's new policies have been translated into appropriate force structures, deployments, exercises, and doctrine consistent with a "defensive" strategy. Soviet defence spending and the tempo of military activities have clearly been reduced. Finally, political primacy and authority over the military has been firmly reinforced, and parliamentary or Supreme Soviet oversight of military matters has been instituted. The Soviet modernization programmes currently underway were authorized in the mid- to late-1970s and early-1980s, and, as in the US, strategic programmes extend over a longer period of time and are difficult to cut back in mid-stream. What the Soviets will do later in this decade will reflect decisions made under Gorbachev, and increased openness and transparency together with Supreme Soviet oversight might provide a window into what the Soviets plan in the strategic nuclear sphere.

Responsible Western decision-makers are correct in striking a somewhat cautious note as long as Soviet words on strategic arms reduction are not translated into negotiated agreements. However, there are good reasons to expect a strategic arms reduction treaty in the near future. If the USSR comes even close to implementing its announced arms control agenda, it will have divested itself of advantages in a whole series of limited military options that it spent billions of roubles to acquire over the last couple of decades.

Aside from assured destruction, the only option in which Soviet posture will probably not be materially impaired by arms control is that for fighting a limited intercontinental nuclear war. The proposed reductions under START will cut into Soviet counterforce capabilities to an extent, but it might also make counterforce commensurately easier by limiting the number of US targets that would need to be attacked. Moscow seems prepared to abandon its advantages in all other limited options: Eurostrategic, theatre-nuclear, conventional, and even naval forces (excluding SSBNs). Finally, it is quite likely that, within this decade, the West could find itself challenged by the USSR to negotiate seriously on really deep reductions in strategic nuclear arsenals.

3. UNITED STATES STRATEGIC DEVELOPMENTS AND THEIR IMPLICATIONS

Prior to the establishment of the Strategic Defense Initiative (SDI) in 1983, US strategic doctrine in relation to air defence went through three phases: early attempts to deploy heavy defences, the debate about ballistic missile defence (BMD), and, in the aftermath of the decision to forego defences against the ballistic missile, a heavy emphasis on surveillance and a minimal approach to active defence.

Air Defence at its Peak

Between 1957 and 1962, the United States Air Force (USAF), in cooperation with the Royal Canadian Air Force (RCAF), built a formidable air defence system for North America. The northernmost front of the system was the DEW line, constructed in 1955 and 1956 roughly across the 70th parallel as a cooperative project between the United States and Canada. With 2,000 interceptors, 250,000 personnel, and operating expenses over US$6.6 billion in 1985 dollars, NORAD was second only to Strategic Air Command in absorbing USAF resources. Similarly, in Canada at its peak strength the RCAF deployed more than 160 front line interceptors supported by 17,000 personnel.

As it approached peak operating strength, this massive air defence system was overtaken by technological developments. The vulnerability of the air defence system itself to attack by ballistic missiles, combined with the technological complexity of developing a defence against ballistic missiles, led US Defence Secretary Robert MacNamara to redefine the task of air defence as primarily surveillance and warning. After 1962, a progressive phase out of air defence interceptor squadrons began while, with the construction of the Ballistic Missile Early Warning System (BMEWS) and the development of surveillance satellites, the emphasis in NORAD shifted increasingly to aerospace surveillance and tracking.

The ABM Debate

In 1967, a major debate took place in the United States about the deployment of an Anti-Ballistic Missile (ABM) system. In the outcome, the Johnson Administration compromised by opting for a limited defence of ICBM silos. Canada's great concern was that it would be drawn into an extremely expensive and potentially destabilising arms race triggered by the construction of ABM defences. This led to the insertion in the 1968 NORAD renewal of a statement to the effect that Canada would not be involved in ABM defences. Such worries, however, were allayed some four years afterwards when the Nixon Administration negotiated the ABM Treaty with the Soviet Union, with a companion Interim Agreement placing ceilings on strategic ballistic missiles deployments.

The Coastguard of the Air

The ABM Treaty appeared to settle indefinitely the importance to be placed on strategic air defence. With a treaty effectively prohibiting ballistic missile defences, there was little point in committing resources to air defence. By 1972, it was clear that NORAD was no longer intended to provide a strategic air defence for cities or major military targets, but only to provide a limited defence against a small bomber attack, and, of course, to provide warning of both bomber and ballistic missile attack. After 1972, NORAD's role was primarily surveillance. Its guard task was effectively summarised as "a coastguard of the air".

The Strategic Defense Initiative

In 1983, President Reagan declared his intention to initiate an intensive research programme for the purpose of developing a comprehensive defence against ballistic missiles. The Strategic Defense Initiative Organization (SDIO) was created as a direct response to President Reagan's speech. At the time of the 1986 renewal of NORAD, a

protracted debate was underway, both in the United States and Canada, about the feasibility and timing of deploying ABM defences on a sufficient scale to constitute a near leak-proof defence against ICBM attack. This debate was wide ranging and provocative. Some had expectations that SDI would lead to early, extensive deployments of ABM defences, both ground based and space-based. Particularly in regard to space-based systems, there was also considerable speculation about the possibility of using "exotic" technologies such as space-based lasers and electro-magnetic rail guns.

Canadian Responses

In Canada, therefore, many questions were raised about the potential involvement of the country in this radical departure from the approach to strategic stability based on the ABM Treaty and the fundamental premise of mutual assured destruction. These questions focussed in part on the prospect that some proposed ABM systems appeared to involve potential deployments on Canadian territory, and in part on the broader implications of an arms race induced by the quest for ballistic missile defences. In any event, it was apparent that, to be strategically useful, ballistic missile defences would need to be accompanied by extensive air defences -- new "walls" to accompany the new "roof" promised by the SDI programme.

In the spring of 1985, US Defense Secretary Caspar Weinberger issued an invitation to US allies, including Canada, to formally participate in the SDI research programme. As the command with primary responsibility for space-based surveillance and tracking, United States Unified Space Command (USC) – to which NORAD provides information – seemed certain to play a major role in the operation of a deployed ABM system. Moreover, if the Reagan Administration and its successors followed through with the actual deployment of a large-scale ABM defence, it was evident that much greater effort and research would be required to improve air defences. So much seemed apparent from the establishment of a US programme in 1985 entitled the Air Defense Initiative (ADI).

The renewal of NORAD in 1986, therefore, was surrounded by strategic uncertainty and political debate.

Slowing Down SDI

Certain features of the SDI programme came into focus very shortly after the 1986 NORAD renewal. The SDIO Report to Congress in 1986, for example, defined the programme in a manner considerably more cautious than much of the earlier discussion:

> The goal of the SDI is to conduct a program of vigorous research and technology development that may lead to strategic defense options that would eliminate the threat posed by ballistic missiles, and thereby:
>
> - support a better basis for deterring aggression;
> - strengthen strategic stability; and,
> - increase the security of the United States and its allies.

The Report went on to note that the goal was "an informed decision in the early 1990s on whether or not to develop and deploy a defense of the United States and its Allies against ballistic missiles."

The Air Defense Initiative

This relatively cautious approach to the development of the SDI programme is reflected in the ADI programme. ADI was construed at the outset as a matching programme to SDI, with a mandate to evaluate systems for high performance defences against bombers in the same time frame -- the early 1990s -- as the SDI programme itself. While advanced bomber defences would be a necessary adjunct to defence against ballistic missiles, in neither resources nor technologies has ADI emerged as a true companion project. The funding programme for ADI, for example, has been limited to

annual expenditures only gradually approaching some $200 million per year, or otherwise only a fraction of the resources committed to and planned for SDI.

Partly as a consequence of the limited funding, the ADI research programme, unlike SDI, has placed relatively little emphasis on new techniques for destroying incoming aircraft. Its primary emphasis has been on advanced surveillance systems intended to detect and track the new generation of small, elusive targets with very low radar profiles. These include low flying, air-launched cruise missiles, stealth aircraft, submarines and submarine launched cruise missiles.

While many of the technologies under investigation are innovative, the research can be seen as an attempt to restore to the defence the ability to detect attack, for example by improving both passive and active sensing systems against cruise missiles. Only secondarily is the emphasis on interception, and here, despite the prospect of some "cross-over" technologies with SDI in which, for example, lasers might eventually prove to be viable defences against aircraft, there appears to be little pressure to hasten the development of advanced high technology interceptor weapons.

Force Modernization and the Air Breathing Threat

Despite the relatively small scale nature of the ADI programme, it should be noted that defence against air breathing threats may become more important if only because of changes in strategic nuclear forces. In addition to the modernization of ballistic missile forces, both sides are still committed to the development and deployment of "stealth" bombers and new generations of cruise missiles with stealth characteristics. It is likely that these developments will increase interest in high technology surveillance systems able to detect both stealth bombers and supersonic stealth cruise missiles.

SDI Under President Bush

Under the Bush Administration, a cautious tone has also characterised the mission statements of the SDI programme. In the last year of the Reagan administration, Congressional support for the SDI declined with budgetary appropriations for the first time significantly lower than requested, and in FY 1990, actually lower in absolute terms than the previous year. This pattern has continued under President Bush. With less than $3 billion authorized in Fiscal Years 1991 and 1992, the SDI remains a well funded, vigorous research programme, but it no longer holds the prospect of the crash deployment programme that was so much discussed in 1985 and 1986.

The relative decline in funds allocated to the SDI has been matched by changes in the rationale and direction of the programme. Under Reagan, the search for leak-proof defences against ballistic missiles was presented as a superior alternative to mutual assured destruction. The purpose of the SDI was to make nuclear weapons "impotent and obsolete". In the Bush Administration, declaratory policy has changed. The final goal of an impenetrable shield against nuclear weapons is rarely mentioned, even though the President continues to speak strongly in support of the search for meaningful strategic defences.

President Bush, however, has couched SDI primarily in terms of deterrence policy. Strategic defences are now officially presented as one means to reinforce deterrence and diminish the chances of miscalculation or accident leading to nuclear war. The SDI, in sum, no longer promises a visionary solution to the problem of nuclear weapons, but only an exploration of new and promising technologies.

Phase 1 SDI

This shift in strategic approach is reflected in the SDI technology research programme. In 1987, an attempt was made to focus SDI research on several elements collectively identified as Phase I of the SDI programme. These elements include ground and space-based surveillance systems, a space-based interceptor and a ground-based interceptor system, and a programme for battle management. While not presented as the actual components of an ABM system, these technologies have been identified as those most appropriate for "demonstration and validation" so that decisions concerning deployment could be made by 1992.

This cautious refinement of the SDI programme was partially derailed in 1988 when a new programme called Brilliant Pebbles seemed to promise some dramatic short cuts to deployment of an ABM defence. Brilliant Pebbles envisages the deployment of thousands of small, possibly inexpensive rockets in space, which would home in on the exhaust of the attacking missile and destroy by impact. In theory, Brilliant Pebbles could replace some of the Phase I elements and lead to early deployment of an ABM system at an acceptable cost. Although the project was enthusiastically endorsed at the outset, however, more recently a distinct note of caution can be found in discussions of Brilliant Pebbles, suggesting that, at very least, there will be a lengthy period of research and development before Brilliant Pebbles is embraced as the centrepiece of an ABM system.

Implications for Canada

In these circumstances, the greatest import of the continuing SDI programme for Canada may still lie in the comment of the US Defense Science Board in explaining the Phase I programme:

> We believe that it would be better to think about ballistic missile defenses as first of all a surveillance system together with its associate processing and

> communications, whose purpose is to determine the actual characteristics of an attack ... Given such information, decisions can be made within existing limitations. Actions can range from alerting to dispersal, to active defense, to striking back. Without adequate information, none of these actions can be confidently taken.

Although the prospect of dramatic breakthroughs such as Brilliant Pebbles cannot be dismissed, the SDI programme appears to be considerably more predictable in 1991 than it was at the time of the last NORAD renewal. The Phase I programme at best promises only a partial ABM system, and is unlikely to lead to discussions of deployments on Canadian territory. In any event, it is difficult to foresee even partial ABM deployments before the mid-1990s, suggesting a relatively stable situation in regard to strategic defences over the next five years. At the same time, the emerging emphasis on the exploration of new surveillance technologies both in SDI and ADI has long term implications for Canada that need to be addressed.

In 1985, Canada declined to participate formally in the SDI programme while leaving Canadian firms to participate as appropriate. However, since 1985, very few SDI contracts have been awarded to Canadian companies. In 1987, the Defence White Paper announced that Canada would participate in the ADI programme and was initiating a five year programme on space-based radar for the tracking of aircraft and cruise missiles. Despite these decisions, it is evident that the direction of the US ADI and SDI programmes needs to be reviewed very carefully by the Canadian government.

In what promises to be a relatively stable, evolutionary period of technological development, the United States is emphasising a variety of surveillance technologies as the essential element of both future deterrence and strategic defence. In particular, two developments are of importance. First, unless Canada participates in the exploration of space-based systems, it will face the prospect that large areas of Canada may be better monitored by the United States than by Canada itself.

Second, ADI research has focussed on the use of advanced techniques to detect and track submarine-launched cruise missiles. Since the surveillance of its maritime approaches is a vital requirement for Canada, it cannot afford to ignore developments which may both increase the threat from submarine-launched cruise missiles, and intensify the search to locate both the submarine and the cruise missile in flight. It is partly for these reasons that the possibility of an "underwater NORAD" has been occasionally raised in recent years.

If Canada is not to lose control of the surveillance of its own territory, we will need to keep up with these developments in US strategic thinking. In effect, this means that careful thought is required about the future of Canadian involvement in research on emerging surveillance technologies.

4. STRATEGIC ARMS CONTROL

The US-USSR negotiations on a strategic arms reduction treaty (START), which began in 1982, have sought to control the size of superpower intercontinental-range nuclear forces, comprising: land-based ballistic missiles (ICBMs); sea-launched ballistic missiles (SLBMs); and long-range or strategic nuclear-armed bombers. (Strategic systems are defined as having ranges in excess of 5,500 kilometres and are capable of hitting the territory of the other superpower.)

Over the past five years, the United States and the Soviet Union have drawn up the basic framework of a strategic arms reduction treaty (START). Agreement exists, in principle, for each side to reduce its strategic nuclear forces to a nominal maximum of 6,000 accountable nuclear warheads on 1,600 deployed launchers -- i.e., a mix of Inter-continental Ballistic Missiles (ICBMs), submarine-launched ballistic missiles (SLBMs), and long-range bombers -- to be phased in over seven years. Warheads on ballistic missiles are to be limited to 4,900; while the number of nuclear-armed, long-range, air-launched cruise missiles (ALCMs) is not to exceed 1,100. As well, the Soviets are to cut by half

their force of 308 SS-18 "heavy" ICBMs[7] each carrying 10 nuclear warheads, and to reduce their aggregate ballistic missile throwweight by fifty percent. The two sides have agreed to a maximum limit of 880 for deployed nuclear-armed, sea-launched cruise missiles (SLCMs) outside of START, in a separate politically binding agreement not subject to verification.

The Bush Administration, in a departure from previous US policy, has already negotiated certain predictability and stability measures, that both sides are currently implementing, prior to a START agreement. These measures include, among others: advance notification of exercises involving strategic missiles and bombers; a ban on low-flying or "depressed trajectory" missiles; and an experiment to verify the number of warheads on ballistic missiles. The real importance of these measures is that they codify the USSR's new approach to openness and transparency in military affairs.

The terms predictability and stability, however, apparently have very different meanings in the strategic lexicons of the United States and the Soviet Union. For the United States, predictability means, among other measures, an information exchange on military activities, and reciprocal visits to facilities working on strategic defences under the "broad" (or permissive) interpretation of the 1972 US/USSR Anti-Ballistic Missile (ABM) Treaty -- thus allowing for ABM systems in space, based on exotic technologies, as currently being researched and tested under the US Strategic Defense Initiative (SDI) programme. In contrast, the traditional (or "narrow") interpretation of the Treaty limits ABM systems, in the US and the USSR, to 100 interceptor-missiles at a single, fixed, ground-based site.

The Soviets, on the other hand, understand predictability as establishing numerical limits or parameters on research and development of SDI technologies, particularly space-based systems, within the traditional or "narrow" interpretation of the ABM Treaty.

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[7] Intercontinental ballistic missiles capable of carrying more than six warheads/re-entry vehicles are defined as "heavy" missiles in the draft text of START.

In the Soviet view, strategic stability would be enhanced by reductions beyond those agreed under START, i.e., START II, and strengthening the ABM Treaty through establishing additional limits or measures. The United States, in contrast, considers discussions on strategic stability as enabling it to move toward future deployment of strategic defences without threatening deterrence stability.

START and Stability

The underlying aim of START is one of avoiding a nuclear war. Thus, both superpowers are strongly interested in strengthening crisis (or first-strike) stability. This means reducing the chances of any direct military conflict by making retaliatory (or second-strike) forces less vulnerable, and reducing any incentives on either side to launch a nuclear first-strike.

The US/USSR strategic arms reduction talks aim to establish both structural and operational arms control measures. The former include reductions in strategic offensive forces and strengthening deterrent capabilities. The latter include establishing procedures and mechanisms to create military transparency through information exchanges, crisis control centres, on-site monitoring, and advance notification of strategic exercises, among others.

The prospects for achieving a START agreement seem optimistic, even though certain technical details and some major policy differences need to be sorted out before a treaty can be ready for signature, sometime early in 1991.

The Prospective START Agreement

Quantitative Constraints

The present framework of a START agreement raises a number of significant questions for both Canadian and international security and arms control interests. While both the United States and the Soviet Union refer to a START agreement as reducing strategic offensive weapons by 50 percent, generous counting rules for bomber-carried weapons, plus the exclusion of long-range nuclear-armed sea-launched cruise missiles, means that the actual reduction in deployed warhead numbers is estimated to be about 15 percent rather than 50 percent as claimed. [Bomber-carried weapons include gravity (or air dropped) nuclear bombs, short-range nuclear-armed attack missiles (SRAMs), and long-range nuclear-armed air-launched cruise missiles (ALCMs)]. In fact, even after implementing START-mandated reductions, both superpowers will have more deployed strategic warheads than they had at the commencement of the negotiations.

By way of explanation, the bomber counting rule as agreed between the two sides would count each modern strategic bomber carrying up to 24 nuclear-armed gravity bombs or SRAMs as only *one* warhead under the 6,000 warhead nominal ceiling, and not as 24. Thus the United States could deploy some 3,500 SRAMs/gravity bombs that would escape START limits, while the Soviet Union could add some 2,300 such non-accountable nuclear weapons.

The United States has prevailed in charging ALCM-capable strategic bombers with only a notional count of 10 missiles under the 6,000 warhead nominal ceiling, rather than the actual number carried which could be as high as 16 to 20, on the grounds that ballistic missiles are more threatening than bombers. (Long-range ALCMs are defined as those with a range in excess of 600 kilometres.)

Non-nuclear, i.e., conventional, ALCMs are exempted from START restrictions. Non-deployed nuclear ALCMs, however, can be stockpiled in great numbers, since only their launchers -- heavy bombers -- are treaty limited items, and deployed nuclear ALCMs

are to be counted only in relation to strategic bombers as outlined above. Hence, both sides are free to deploy even more non-accountable weapons under START.

In fairness, however, the START sub-limit of 4,900 warheads on ballistic missiles (within the 6,000 overall nominal ceiling) would mandate a cut of close to 34 percent for the United States and nearly 53 percent for the Soviet Union.[8] Also, the Soviets have agreed to cut by half their present force of 308 SS-18 ("heavy") ICBMs with 10 warheads apiece to 154 launchers with 1,054 warheads. However, the United States' advantage over the Soviet Union in the numbers of deployed warheads and bombers will continue even after a START agreement is implemented, if both accountable and non-accountable warheads and bombers are counted (given the counting rule referred to above).

Qualitative Restraints

A START agreement, unlike SALT II, does not ban strategic modernization except in the case of heavy missiles. Neither side will have to give up any of its current nuclear modernization programmes. In the case of the United States these include, for example, the SRAM II, the low-observable (or "stealth") technology strategic bomber (B-2), the *Trident* II (D-5) SLBM, the *Ohio*-class SLBM carrying submarine (SSBN), the advanced ALCM (AGM-129A and its successor), the *Tomahawk* land-attack cruise missile, and the 10-warhead MX ICBM; in the case of the Soviet Union, the list includes the 10-warhead rail-mobile/fixed-silo deployed SS-24 ICBM, the single-warhead road-mobile SS-25 ICBM, the SS-N-20 and SS-N-23 SLBMs, cruise missiles (AS-X-19, SS-N-21, SS-NX-24), the *Typhoon*- and *Delta* IV-class SSBNs, and the TU-160 (*Blackjack*) strategic bomber.

What is clear is that over the likely START implementation period -- 1992 to 1998 -- strategic forces will be constrained as compared to force projections in the absence of arms control. Regarding Soviet forces, in particular, US intelligence estimates

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[8] Based on unclassified estimates, see: *Arms Control Update: USSR-US Strategic Nuclear Forces*, Canadian Centre for Arms Control and Disarmament, Ottawa, 15 October 1990.

note that, without START, the USSR could deploy up to 13,000 strategic nuclear warheads by the mid-1990s; and, given substantial, additional resources, could have the potential to deploy up to 21,000 warheads, as compared with the present 11,500. Current and projected economic and political indicators, however, point to a lower rate, in keeping with START constraints.

There is concern that a START agreement would enable both sides to carry out open-ended nuclear modernization programmes, since it will not ban future weapons systems. In the absence of true 50 percent reductions, and given a free rein to develop, test and deploy new generations of advanced and more capable weapons, both sides will tend to retire older systems under START, thus resulting in relatively smaller but more capable strategic offensive forces.

Canadian and international security could be enhanced if a SALT-type (but better defined) ban on the modernization of START-permitted systems were to be instituted in a follow-on START-II agreement, thus contributing to relatively enhanced stability at lower levels of armaments. It would be in Canada's security interest if START-II were to include such measures as: a limit on the modernization of ballistic missiles; restriction of strategic bombers to only one new type each; lower limits on ALCMs (both deployed and non-deployed); and a ban on nuclear-armed land-attack SLCMs.

Cruise Missiles

The prospect of the Soviets developing and deploying new cruise missiles, as allowed under START, has to be particularly daunting to Canadian and North American Aerospace Defence (NORAD) planners.

Projected Soviet deployment of ALCMs and SLCMs capable of hitting targets in North America has already resulted in increasing interest in a buildup of advanced air defences to counter this "air-breathing" threat. Future air defence technologies are currently being explored by the United States, with some Canadian participation, in the

Air Defence Initiative (ADI). A significant increase in the cost of "thickened" continental air defences could have serious implications for Canadian defence planning and budgeting.

The Evolving Strategic Milieu

In the five years since Parliament last considered continental aerospace defence arrangements, profound political, military and economic changes have taken place in the world. The Cold War is over, and at present the risk of a war between the US and the USSR is not considered a significant factor in East-West relations. Soviet strategic forces, nonetheless, continue to be modernized and by their very existence present a direct military problem for North America.

There are at least four important issues of relevance to any future extension of NORAD: 1) Strategic bomber and cruise missile modernization; 2) START constraints; 3) a proposal for limits on Soviet strategic air defences; and 4) a new perspective on multilateral circumpolar aerial surveillance.

1. Strategic Bomber and Cruise Missile Modernization: The Soviets are currently producing three types of bombers: TU-95/TU-142 (*Bear*), TU-22M/TU-26 (*Backfire*), and TU-160 (*Blackjack*). At present, the Soviet Air Force's principal long-range cruise missile carriers are the ninety TU-142 (or TU-95H version) bombers, designed specifically to carry eight[9] 3,000 km range AS-15 ALCMs each. The *Blackjack* is the Soviets' newest strategic bomber, some 21 of which are operationally deployed. The *Blackjack* can carry six AS-15 ALCMs or twelve AS-16 short-range attack missiles (SRAM) on its internal rotary launcher. The *Backfire* is a medium-range bomber, that is unable to reach North America without in-flight refuelling, and its inclusion/exclusion in START is currently in dispute.

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[9] Under the START bomber counting rule, while the *Bear* (TU-95/TU-142) bomber could carry up to twelve ALCMs, the first 210 bombers will be counted as carrying only eight missiles each.

Like the US, the Soviets are working on an advanced cruise missile (ACM). The Soviet AS-X-19 ACM, with a range in excess of 3,000 km, will reportedly be ready for deployment on *Bear* and *Blackjack* bombers later in this decade.

In addition to ALCMs, Soviet long-range nuclear-armed sea-launched cruise missiles (SLCMs) also threaten North America. Deployment of new 3,000 km range SS-N-21 SLCMs continues on three classes of modern nuclear-powered general-purpose submarines: reconfigured *Yankee-Notch*, *Sierra*, and *Akula*. An advanced sea-launched cruise missile, the SS-NX-24, is also under development together with a new submarine to carry it, although deployment is not expected in the near-term.

Current USSR/US (nuclear and non-nuclear) cruise missile deployment schedules project an eventual proliferation of potentially several thousands of air- and sea-launched versions.

2. US-USSR Strategic Arms Reduction Talks: The current START agreement framework, as noted above, encourages the Soviet Union, in particular, to build-up its strategic bomber and cruise missile forces. Any Soviet increase in these systems, however, would only serve to complicate North American continental aerial surveillance and defence efforts.

Preliminary projections of potential Soviet strategic forces under START indicate an increase in ALCMs to 1,300 from the present 540,[10] gravity bombs/SRAMs to 960 from the present 616, deployed on 130 *Bear* bombers (carrying 10 ALCMs each) and 60 *Blackjack* bombers (carrying 16 bombs/SRAMs each). START will allow the Soviets

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[10] See, for example, *Arms Control Update: USSR-US Strategic Nuclear Forces*, Canadian Centre for Arms Control and Disarmament, Ottawa, 15 October 1990.

flexibility to deploy *Blackjack* bombers, above the 60 noted here based on US intelligence estimates.[11]

3. Soviet Strategic Air Defence Limits: The Soviet Union has deployed the world's largest and most complex, multiple-layered network of territorial or strategic air defences, based on a combination of large radars, surface-to-air missile (SAM) batteries, and interceptor aircraft; which is complemented by 100 anti-ballistic missiles near Moscow (under the terms of the ABM Treaty). As well, the Soviets are continuing with research and development efforts in both active and passive strategic defence measures.

Soviet strategic air and space defence efforts complicate the ability of the US to maintain deterrence and affect the credibility of US strategic offensive systems. Continuing improvements in Soviet strategic air defences will, by the turn of the century, seriously degrade the ability of US B-52 and B-1B bombers to penetrate to their targets. The extended range of new Soviet SAMs and interceptors, together with Airborne Early Warning and Control System (AWACS)-type aircraft, make it easier for the Soviets to counter US "penetrating" and even "stand-off" bombers.[12]

One way in which the US is trying to regain its "penetration" capability is to develop the new B-2 bomber with low-observable, or "stealth", features. The "stealth" bomber, contrary to popular belief, is not invisible to radar, but is harder to detect frontally as compared to older bombers. This technology does not come cheap, and the

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[11] Recently reported US intelligence estimates note that potential Soviet strategic forces under START could comprise of additional TU-160 bombers. As well, according to the 1990 edition of the US Defense Department publication, *Soviet Military Power*, about 75 percent of the Soviet post-START bomber force will consist of modern ALCM-equipped aircraft, which will give it an enhanced strategic strike capability -- (and not only would this be legal under START, but the US would have encouraged the Soviets to do so).

[12] Strategic bombers carrying gravity bombs or short-range attack missiles (SRAMs) need to "penetrate" or get through air defences to their targets, while "stand-off" bombers release their payload of cruise missiles several hundred kilometres off the coastline of the adversary's territory.

expected cost per copy of the 15 B-2s that the US Congress has authorized funding for is rapidly approaching nearly US$1 billion.

Negotiated limits on Soviet strategic or territorial air defences would be in the best interest of preserving strategic stability. Specifically, such limits could be explored for each of the major components of modern air defences: strategic radars, interceptors, air defence missiles, and battle management systems. It should be noted here that the aim would be to limit overly large-scale, multiple-layered, strategic air defences, since early warning, surveillance, and limited air defence capabilities are stabilizing. Hence, the burden of limitations would fall asymmetrically on the USSR. The case for limits on Soviet strategic air defences should be carefully assessed, possibly in connection with corresponding restrictions (under START II) on "penetrating" bombers, and long-range nuclear-armed cruise missiles, that such systems are designed to counter.

4. Multilateral Aerospace Surveillance: Even with NORAD, Canada lacks a national surveillance system in its central and northern areas that would be useful for both military and civilian requirements, such as surveillance, identification and tracking, sovereignty assertion, environmental protection and monitoring, and resource development.

At present, Canada is cooperating with the United States in developing a space-based radar (SBR) for NORAD, to help detect and track objects as small as cruise missiles. This project is estimated to cost about US$10 billion or more. It should be noted that for Canada there should be no inherent conflict between participation in an international circumpolar surveillance system and continued partnership in NORAD. However, attention should turn to a possible post-Cold War approach in which aerospace surveillance and warning information is shared among cooperating nations.

Canada should evaluate the feasibility of a multilateral space-based radar system, serving all the Arctic circumpolar states, that fulfils both military and civilian functions. It would have a security role in the sense that it would permit the monitoring of surface and atmospheric traffic, as well as fulfilling various civilian surveillance requirements.

Canada's Position

While Canada is not a party to the START negotiations, it nevertheless has clear and pressing arms control and defence related interests in the outcome of a START agreement. Over the past few years, Canada has supported limits on ALCMs and SLCMs, adherence to a "strict" or "narrow" interpretation of the ABM Treaty (which prohibits both mobile and space-based SDI-type anti-missile systems), and stability at lower levels of armaments.

These positions, while being both sensible and desirable, do not, however, go far enough in protecting Canadian security interests. In parallel with Canada's active involvement in multilateral security matters, for example, conventional force reductions in Europe, and negotiations at the Conference on Disarmament in Geneva on a chemical weapons ban, Ottawa should also push bilateral (Canada-United States) security interests in Washington. Apparently the official view is that because Canada is not present at the START negotiations, it is not in a strong position to make suggestions to Washington or to raise concerns regarding such issues as US strategic modernization or force structure.

The Future

The emerging East-West détente raises the possibility of further reductions beyond those to be achieved under a START agreement. These developments have given rise to some new thinking on the concept of minimum deterrence, which postulates that going to zero nuclear weapons would lead to instability; hence, some minimum number of nuclear weapons should be retained.

To benefit fully from a START world, both sides will have to address a series of important, but not necessarily unresolvable questions, relating to future strategic offensive force structures that do not rely on highly MIRVed ballistic missiles, as well as the future disposition of strategic defences (if any). These and other related questions will have to

be resolved between 1992 and 1998, the likely implementation period for START. The two sides have agreed to follow-on negotiations immediately following the conclusion of START I, but any "deep cuts" in strategic offensive forces -- i.e., down to about 3,000 warheads, or less, each -- will not be possible at least until the turn of the century. This is because it is unlikely that a follow-on START II agreement could be implemented until after reductions mandated under START I had been completed, and the effects on strategic force structures fully comprehended. (Both the US and the USSR have still to figure out precisely how they will restructure their strategic forces in a post-START world, and any subsequent cuts would have to await assessments on strategic stability and decisions on new force structures.)

If "minimum deterrence", based on minimal strategic forces of between 600 to 2,000 warheads each, is achievable, it is not likely much before 2010, as new force structures will have to be devised. And this process would have to involve the full participation of the other three declared nuclear powers, China, France, and the United Kingdom, as well as any others that by then might have joined the nuclear club.

Despite the recent fundamental restructuring of the East-West relationship,[13] the basics of strategic deterrence and stability are not likely to change dramatically over the next couple of decades. As noted above, even after START-mandated reductions both superpowers will retain strategic offensive arsenals containing an estimated combined total of nearly 20,000 accountable (as opposed to deployed) warheads and 3,200 strategic launchers. Even though the threat of a Soviet attack on the US has never been lower, and in reality was never really high due to US strategic superiority, until both superpowers achieve radical "real" cuts in strategic forces, deterrence stability will continue to be premised primarily on a counterforce posture, i.e., on offensive deterrence. Any

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[13] Despite the breath-taking changes underway in Eastern Europe and the Soviet Union, and rapid progress in arms control talks, it is important to note that a US-USSR strategic arms control agreement has not been signed since 1979. As 1990 ends, however, there is hope that a START agreement can be concluded by early next year.

transition, if at all possible, to defensive deterrence, which would be based on deployed strategic defences and reduced strategic offensive forces, would have to be negotiated and implemented in such a way as not to provide any perceived benefits for a breakout or a surprise attack during the transition period. Such a stable transition is not achievable in the near future. Only really deep cuts can remove the capacity of each superpower to conduct an effective attack on the other's strategic forces, while leaving sufficient capability to meet other legitimate mission requirements, such as retaliation and targeting military infrastructure (other than weapons).

5. AEROSPACE SURVEILLANCE

The Role of Aerospace Surveillance in the Preservation of Stable Strategic Deterrence

In order to establish a state of strategic deterrence, an arsenal of long-range nuclear weapons had to be deployed. To make the strategic deterrence stable in time of crisis, it was necessary to reduce the vulnerability of the retaliatory weapons. In North America both of these measures were taken by the United States alone, the custodian of the deterrent. But other crucial steps were also necessary, in order to ensure that the system for the command and control of the weapons was able to survive attack, and received the information it needed to carry out its function.

With accurate and complete information, the command and control system could perform its two vital roles: if an attack were really under way, to alert the retaliatory system and initiate such measures as were possible to provide defence; and, if an attack was not under way, *not* to do any of these things. For this, the US and Canada would require completely reliable world-wide surveillance of the movements of all potentially hostile long-range bomber aircraft, and of the launching and flight of all ballistic missiles and cruise missiles that could reach North America.

But if the surveillance is less than 100 percent reliable, and its coverage less than world-wide, the possibility must be faced of two undesirable outcomes. One would be to arrive at the conclusion that an attack *was* under way, when this was *not* in fact the case. The other would be to *fail* to recognize that an attack was under way, when in fact it *had* actually started. The consequences of the error of the first kind can be ameliorated by making sure that no irreversible steps are taken (such as the launching of ballistic missiles) before weapons have actually detonated on North America (i.e., no "Launch on Warning"). But the consequences of the error of the second kind could be absolutely catastrophic: decapitation of the leadership, command, and control. If an enemy considered this to offer a real possibility, it would represent a significant blow to the continuation of stable strategic deterrence.

What is vital is the provision of surveillance over North America and the approaches to the continent of activities in the air and in space that could represent the beginning of a strategic attack. The prime targets for surveillance include bomber aircraft, ICBMs, SLBMs, and cruise missiles (ALCMs and SLCMs). The necessary operations include not only detection of these objects, but also identification of the bombers against a background of legitimate air traffic, an estimate of the trajectories and likely points of impact of the missiles, and general collection and assembly of relevant military and diplomatic activity that must be taken into account in order to assess the situation. Activities of foreign space vehicles could be a factor, as could naval movements. All of this information needs to be collected and processed, quickly and effectively, and the assessments made available to the leaderships of the United States and Canada.

Nearly all of the likely targets for a disarming first strike against North America are in the United States. But if the attack originated in Europe or Asia, while SLBMs could be launched from the Atlantic, Pacific, or Caribbean coasts of the United States, the shortest routes for missiles and aircraft lead over the Arctic and over Canada, Greenland, and Alaska.

The North Warning System provides detection of the approach of aircraft from the north, and the Forward Operating Locations in Northern Canada enable Canadian or American interceptors to carry out identification long before bombers could penetrate to targets farther south. It is, however, doubtful that the NWS or the interceptors could detect or track cruise missiles, and they are impotent against ballistic missiles. NORAD obtains its warning of air approach from the east or the west by Over-the-Horizon and other ground-based radars, and its surveillance against ICBMs, SLBMs, and space vehicles from radars based in Alaska, Greenland, the United Kingdom, and on the coasts of the United States, and mounted on satellites in geostationary orbits above the equator.

In short, stable strategic deterrence requires surveillance of the approach towards North America of threatening objects from any direction, whether in or above the atmosphere. Above the atmosphere, the United States conducts surveillance in all directions. So it does against the approach of air-breathing threats across the Atlantic, Pacific, and from the south. But surveillance of airborne approach from the north is the responsibility of Canada, and all of the information must be combined into a single integrated system.

Present and Future Surveillance Technology

Radar provides the most effective sensor for the detection and tracking of aircraft or missiles in flight. But, when sited on the ground, it is unable to see objects beyond (i.e., below) the horizon established by the surrounding terrain. Because of the curvature of the earth, everything flying at altitudes within the atmosphere will be hidden from a ground-based radar at ranges beyond a few hundred kilometres, and at low altitudes very much less than that. But satellites and ballistic missiles, whose trajectories are typically hundreds of km. above the earth, can be detected at ranges of at least 2,000 km. The North Warning System, a single line of ground-based radars extending over a length of about 4,800 km., requires 13 long-range radars for coverage against aircraft at high altitude, and another 39 short-range radars for low altitude. Low-altitude coverage of all

of Canada's ten million square km. by ground-based radar would require several hundred separate installations. (The USSR has several thousand deployed for air defence.)

While remarkable improvements in technology (such as phased-array radar) have made it possible for one radar installation to track dozens of targets, accurately in three dimensions, and with good resolution, and to combine the information from many stations into a single display at a remote location, the area that can be covered by a ground-based microwave radar against low-flying aircraft is still limited by the line of sight to the horizon.

This fundamental limitation can be overcome in two ways. One is by use of long-wave Over-the-Horizon radar, which employs indirect paths from the ground-based transmitter to the aircraft, and back from the aircraft to the receiver, using reflection from ionized layers in the upper atmosphere. One OTH radar can cover a very large area, tracking aircraft at any altitude. However the equipment is extremely expensive, and has not been able to operate reliably in areas subject to auroral disturbance, associated with the Northern Lights and prevalent over large parts of Northern Canada.

The other way to achieve detection of low-flying aircraft over a large area from a single radar is to place it high above the earth, so that an unobstructed line of sight is available out to very long range. This introduces a new problem, in that the radar receives reflected energy from the earth's surface that exceeds by far the strength of the reflections from the target aircraft. However, modern signal processing technology is now able to cancel the returns from stationary objects on the earth, and display only those signals being reflected by objects that are moving with respect to the earth. The technique (known as Moving Target Indication) is complicated, and a powerful and sophisticated radar is required.

The Airborne Warning and Control System (AWACS) employs a large (EC-3) aircraft to house such a radar, together with displays and work stations for a crew of operators, who are able to control friendly fighter aircraft to intercept unknown targets.

AWACS is far too expensive to permit continuous coverage of an area as large as Canada, but one unit can provide effective surveillance over a limited area for periods of several hours.

The ultimate platform for surveillance from high altitude is an earth satellite. Spaceborne photographic and television cameras (operating in the visible and infrared bands) now produce remarkable images of the earth's surface. An area can be observed that is far larger than that visible from an aircraft, and an image presented that shows a large area with low resolution (insufficient to reveal the presence of an aircraft), *or* a small area with high resolution, adequate to show an aircraft, but only if the small area has been selected to include the place where the aircraft happened to be at the time (e.g., an airfield). Such systems are excellent for periodic observations of small areas of known interest. But they could not provide surveillance of a large area for the movement of aircraft in flight.

Passive sensors such as photographic or television cameras, or radio receivers, are well suited for satellites, as they do not require large payload or much electric power. Passive infrared sensors can detect the heat from an aircraft engine, but only if the line of sight is not obscured by clouds.

Radars of the type mounted in AWACS are heavy, have antennas, and consume a lot of power. By use of Synthetic Aperture Radar, a design which uses advanced signal processing, it is possible to overcome the problem of antenna size, and to obtain high resolution images of *stationary* targets on the earth. But the processing equipment introduces another demand for electric power and has not, to date, allowed this system to distinguish *moving* targets from the large background of reflections from the earth.

The extraordinary progress in computer technology will probably make it possible at some time in the future to combine small Synthetic Aperture Radar with signal processing able to produce either high resolution imagery of stationary targets in a small area or indication of moving targets over a large area. While a heavy demand for power

could be met with a nuclear reactor, this may not be necessary with improvement in solar cells and reduction in the power requirements of computers.

There are two developments which impair the effectiveness of radar for aerospace surveillance. One is the small size of cruise missiles, as compared to long-range bomber aircraft. The second factor is "stealth" technology, which reduces the amount of energy reflected back to a radar from its target. Stealth can be applied to missiles, aircraft, or ships. It utilizes two main methods. One of these is to design the shape of the object so that the energy arriving from the radar transmitter is scattered forward and sideways, rather than being reflected back to the radar receiver. The other method depends on the use of special materials which absorb rather than reflecting electromagnetic energy. Stealth will probably work most effectively against microwave radars, and when the target is being observed in the head-on aspect. It is likely to be less successful against radars operating at longer wavelengths (such as OTH) and observing the targets from above (such as OTH, AWACS, and spaceborne radars), and therefore is less of a threat to the function of surveillance than it is to fire control.

The Promise of Space-based Surveillance

Space-based sensors have an extraordinary potential to provide surveillance over large areas of the earth. The requirement to track aircraft in flight is probably the most difficult to satisfy. In all probability a system which can perform this role will be able to provide many other types of surveillance as well, with a multitude of uses for many national purposes, most of them not related to defence, and several already being performed from space vehicles or aircraft. Examples would include:

- search and rescue
- verification of arms control agreements
- support of United Nations and similar peacekeeping operations
- tracking of surface shipping
- monitoring of water pollution

- monitoring of air pollution
- following the spreading, movement, and melting of ice
- weather prediction
- mapping of remote areas (including shallow water bathometry)
- mineral prospecting.

The cost of a spaceborne system for tracking aircraft will be high. Recent estimates range from $500 million to $1 billion for each satellite, with the number of satellites needed more than half a dozen, and possibly as high as twenty, depending on exactly how much coverage was demanded[14]. But the benefits can be made to extend far beyond the aerospace defence of North America. Depending on the sensors, and the organizations using the information, funding and management could well be shared by agencies responsible for:

- defence (including peacekeeping)
- arms control verification
- air traffic control
- search and rescue (marine and air)
- environmental quality control
- immigration control
- control of illegal importation of narcotics
- meteorology, cartography
- discovery and management of natural resources.

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[14] In *Continental Air Defense: A Neglected Dimension of Strategic Defense*, Arthur Charo estimates the cost of each satellite at $US 0.5 to 1 billion, with ten to nineteen being required (p. 93). W.P. Delaney suggested eight to twenty satellites at $US 750 million to 1 billion apiece (cited in Charo's book, (p. 43). In 1985, the Canadian Special Senate Committee on National Defence estimated that a system comprising eight to twelve satellites might only provide minimum capabilities, at a cost of $Cdn 4.5 billion. (See *NORAD: Its History and its New Challenges*, by Michel Rossignol, Research Branch, Library of Parliament, 1990, p. 29). Daniel Hayward, in *The Air Defence Initiative* (Canadian Centre for Arms Control and Disarmament, 1988, p. 12), indicated that a fifteen to twenty satellite constellation would cost perhaps $Cdn 15 to 20 billion.

With so many applications of national importance for both Canada and the United States, and such large cost, it would seem logical to consider the apportionment of funding and management among several agencies of government, and between the two countries.

A key decision would be whether to limit jurisdiction and use to defence, or to include other agencies of civil government. This would probably depend on the technical capabilities designed into the system. If mainly or totally dedicated to defence and security, shared American-Canadian funding would appear reasonable, and NORAD would probably be the proper agency to operate the surveillance system. But inclusion of even some of these civilian applications would take the operation beyond the compass of NORAD. The major other use of information on the movement of aircraft could be for air traffic control.

Before an informed decision regarding acquisition of a space-based system effective for surveillance of aircraft in flight can be made, considerable technological development, requiring several years, will be needed, after which the decisions and procurement will take more years. By the year 2000, the relative national priorities of the preservation of strategic deterrence, verification of arms control agreements, air traffic control, environmental monitoring, drug enforcement, and other activities of national importance will have changed. Canada may be more, or perhaps less, concerned over measures to maintain its sovereignty. It may wish to acquire an improved capability to observe activity, and perhaps even to be able to intercept aircraft, in Arctic regions. Canada should have learned a great deal from the RADARSAT experiment. A significant number of the services of surveillance satellites (but not including the tracking of aircraft or missiles in flight) may be commercially available, or by government to government arrangements.

There is little doubt that the best technical solution to the provision of surveillance of the movement of aircraft over an area of the size of North America will be to mount advanced radar sensors in a constellation of satellites. But until a number of engineering problems are solved it will be necessary to rely on the ground-based radars of the North Warning System, OTH, and AWACS for quite a few years, before their functions can be

assumed by a spaceborne system, and the performance of the current equipment may be significantly degraded against cruise missiles and stealth technology. Even if the space-based systems are completely successful, some of the air and ground-based sensors will still be required.

The ultimate acquisition of a space-based surveillance system offers many opportunities, and will pose many problems of strategy, finance and organization, for Canada. But these are too far in the future to influence the question of renewal of the NORAD agreement in 1991.

6. US-CANADIAN INTERESTS AND CONSULTATION

While the NORAD Agreement itself has proven to be both durable and at the same time subject to gradual changes in emphasis, US and Canadian policies in surveillance and air defence cooperation have changed substantially over the past thirty years. These changes make it all the more important that Canada emphasise the importance of extensive consultation in the future development of NORAD.

US Interests

For the United States, the gradual transition from the heavy air defences of the early 1960s to an emphasis on space-based surveillance has diminished the role of the binational alliance. This was reflected in the establishment first of Air Force Space Command, and then in 1986, of US Unified Space Command (USC). Unified Space Command, as its name indicates, operates a vast array of ground-based and space-based sensors, providing "99.9 percent sure" warning of ballistic missile attack. For the United States, NORAD is now just one part of the network providing information to USC.

In the context of air defence surveillance alone, the DEW line has been replaced by the jointly developed and funded, Canadian-manned North Warning System (NWS). The NWS is a valuable USC asset, but only one element of a US surveillance net which also includes Over-the Horizon radars based in the continental United States, and, when necessary, Airborne Warning and Control Aircraft (AWACS).

These complementary radar systems, however, are only a part of the USC surveillance network, which also includes the Ballistic Missile Early Warning System (BMEWS), the Satellite Early Warning System, the Naval Space Surveillance System, the Air Force Spacetrack, and many other sensors linked to the USC Combat Operations Centre in Colorado Springs. For the most part, Canada plays no role in the operation of these systems, and its participation in NORAD cannot be assumed to provide an automatic right to the surveillance information provided to the Commander-in-Chief, USC, even though he is also Commander-in-Chief, NORAD.

How important, therefore, is NORAD to the United States? The North Warning System is likely to be of great value for at least the next ten years, and possibly longer, depending on the development of space-based radar. The combined command makes for efficient use of ground control and interceptor aircraft. NORAD provides a framework for the convenient transborder movement of aircraft where otherwise there would be greater potential for misunderstanding and bilateral tensions. Finally, the continuation of the alliance leaves future options open. If an ABM defence against accidental launches or small scale attacks was judged feasible, then deployment on Canadian territory might again be an option. If, in the post-START environment, Arctic-launched SLCMs and ALCMs were to become a larger element of the threat, prudence would suggest that the United States should continue to maintain an agreement which facilitates close cooperation with Canada, particularly in the North.

The United States, therefore, has a continuing interest in the NORAD relationship. However, against these considerations must be set the diminished importance of NORAD in the overall network of surveillance systems reporting to USC. For the United States,

this means that while the bilateral defence relationship is desirable, the value of Canadian territory and support is no longer as crucial as it was in the earlier period. This decrease in the strategic importance of NORAD would be accelerated if the United States decided to deploy space-based radar, thus further reducing its dependence on an early warning system across the Canadian north. It suggests, therefore, that Canada will not find it any easier in the future than in the past to insist that the bilateral alliance creates an obligation to consult on strategic questions broader in scope than the operational issues pertaining to NORAD as a bilateral command.

Canadian Interests

It is evident that the NORAD agreement has a much larger place in Canadian defence policy than it does in US policy. For the United States, it is a binational command which imposes certain limited obligations. For Canada, it constitutes a political and strategic commitment which must be assessed in terms of Canada's broad foreign policy objectives.

In an authoritative parliamentary report,[15] these objectives were described as the promotion of peace and security, sovereignty and independence, national unity, economic prosperity, and justice and democracy. NORAD can be seen as supporting these objectives insofar as it contributes to peace and security, and sovereignty and independence.

The primary function of NORAD -- surveillance and early warning -- clearly contributes to strategic stability. Does the agreement also contribute to sovereignty and independence? First, military cooperation can ensure that there is no disposition, through indifference, neglect, or lack of resources, to allow the United States to act unilaterally in the surveillance and patrol of Canadian airspace. Second, the massive task of

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[15] *Independence and Internationalism*, Report of the Special Joint Committee on Canada's International Relations, June 1986.

controlling Canadian airspace can be best accomplished when undertaken in conjunction with a binational agreement on strategic surveillance and early warning.

Couched in these terms, Canadian interests require consultation between the two countries on a range of strategic and national issues, for experience suggests that the very different concerns of the two countries can lead to serious misunderstanding.

Crisis Response

For Canada, consultation in matters relating to NORAD has been a key issue since the Agreement was first drafted in 1958. At that time the political implications of an integrated military command were not dealt with in the Agreement. Four years later, the Cuban Missile Crisis revealed the dangers: working side-by side with US Air Force personnel, and sometimes in situations where the senior officer was Canadian, the United States placed its forces on a full alert while Canada did not. The political recriminations that followed were extremely serious, while the RCAF was placed in the invidious position of standing down from NORAD duties at the first real test of the integrated command, while at the same time facing criticisms that it had acted against the instructions from its Government.

Since the Cuban Missile Crisis, considerable steps have been taken to improve the consultative process. The Permanent Joint Board on Defence, the Military Cooperation Committee, informal but regular contacts at the political and official levels, all have served to ensure that the working relationships encompassed by the NORAD Agreement are smooth and effective. As the 1973 NORAD alert over the situation in the Middle East indicated, procedures are now in place such that, if the United States goes to a higher state of alert, Canadian forces are not bound to follow, and can be replaced by US personnel. Independent national decision-making, therefore, is both accepted and practical. Nevertheless, the broader issues of consultation, relating essentially to the broad

trends in strategic forces and alliance developments, continue to be a serious issue in Canada, as the following cases suggest.

Strategic Force Developments

It has been noted elsewhere that the START Agreement may well increase the relative importance of strategic bombers, ALCMs and SLCMs. Despite the implications that this would have for the basic tasks of NORAD, it does not appear that participation in the binational command has created an effective Canadian voice in Washington planning on strategic force structures.

NORAD and NATO

Since the first discussions of NORAD, Canada has sought to link NORAD as closely as possible to NATO. In the first instance, in 1958 the Diefenbaker Government described NORAD as an integral part of the NATO Command structure. This position, however, was then and has since been firmly rejected by the United States, which saw few benefits and many complications involved in a system whereby NORAD reported directly to a NATO command. In the present situation, liaison with NATO is maintained through the Canada-US Regional Planning Group. This establishes a link to the NATO Military Committee, but forces assigned to NORAD are not under NATO Command, and NORAD plans are neither developed nor formally approved by the NATO Military Committee.

The transformation in Europe and the end of the Cold War make the present NORAD renewal an appropriate time to review the linkages between NORAD and NATO. This review would consider in particular the relationship between conventional force reductions in Europe and possible changes in the strategic situation, which might include a reduced perception of the intercontinental threat as a consequence of the

improved political relationship between East and West, and increased opportunities to accelerate reductions in strategic nuclear forces. The renewal should also offer an opportunity to review with the United States changes in Soviet force structure, including Soviet cruise missile developments and strategic air defences. It is unlikely, however, that any more formal and direct link between NORAD and NATO than that already established through the Regional Planning Group is practical at the present time.

The Arctic and the North Pacific

The aerospace defence of North America includes both the Arctic and the North Pacific regions. It is reasonable, therefore, to treat air defence through NORAD as an activity integral to national sovereignty and regional security. In the Arctic, Canadian sovereignty is still at issue. Sovereignty over the waters of the Arctic Archipelago is still an unresolved question on the bilateral agenda, even though the decision not to proceed with the Class-8 icebreaker may well be construed to mean that Canada's commitment to the assertion of its sovereignty in the North is only rhetorical. The renewal of NORAD, therefore, is an opportunity to reaffirm Canada's sovereignty in the North. It should also provide an occasion for the Government to demonstrate that it is committed to seeking the involvement of the northern communities in planning defense activities in the Arctic. In addition to national security questions, the bilateral agreement could also become a vehicle for establishing mutual interests in a circumpolar approach to Arctic security and development. Using the Conference on Security and Cooperation in Europe (CSCE) as a model, the strategic threats to the region could be the subject of multilateral discussion, so progressively expanding the mandate of NORAD to respond to multilateral regional questions. At an appropriate time, a similar approach might be taken to the North Pacific region.

Improving the Consultative Processes

The procedures developed for consultation, such as the Permanent Joint Board on Defence, undoubtedly have value. Nevertheless, as the review of trends in US strategic doctrine have indicated, they have not changed the fundamental dilemma that Canada faces in cooperating with the United States in the air defence of the continent. When radical changes of policy are decided in Washington, Canada may react to them, but it has little opportunity to influence policy prior to decisions, even when such decisions have a profound effect upon Canadian security and defence policy. The 1967 decision in Washington to deploy a limited ABM system, the 1983 Star Wars speech by President Reagan, the 1985 decision to invite the allies to formally participate in the research programme, the future course of SDI -- all illustrate that crucial decisions in Washington are made prior to bilateral consultation, not after such consultation.

While Canada must accept the reality that it cannot force its presence on the Washington policy process, the negotiations on the renewal of the NORAD agreement can be used to emphasize the value Canada places on consultative processes. These processes would be enhanced, for example, if steps were taken to ensure that, at regular intervals, political attention in both countries is focussed on emerging issues and irritants in the strategic relationship. One way to accomplish this is to expand the policy process by providing for annual or biennial meetings at the legislative level. For example, joint hearings on NORAD could be discussed with the US House Armed Services Committee. In other years, the Canada-US Parliamentary Group might organize one day of hearings on some of the broad issues identified above. Such consultations, therefore, could cover changes in the strategic environment, such as the spread of ballistic missiles or the implications of START proposals. They would also cover issues of bilateral interest, such as future surveillance systems and advances in technology. They should also discuss matters of special interest, such as collective measures to protect the Arctic and settle outstanding differences in the region.

Such consultative processes at the political level would not guarantee Canadian participation in crucial White House decisions. Joint parliamentary consultations, however, would raise the profile of continental defence issues in Washington, and provide expanded opportunities to establish Canadian interests in strategic questions relating to NORAD.

7. CONCLUSION, OPTIONS AND FINDINGS

Conclusion

We are on the threshold of a new era. The Cold War is over, and the challenge now is to manage the transition to a new period of East-West relations based on co-operation and the eventual pursuit of common security.

Does this mean that Canada's participation is continental aerospace defence is no longer necessary? What are Canada's objectives in this field and how should they be pursued in discussions with the United States as the issue of NORAD renewal is addressed once again in the period leading up to May 1991? Do long-range nuclear weapons no longer pose a danger to Canada and the United States and what are the projections for the development or deployment of strategic defence systems on one side or the other? Would it be prudent now to drop the NORAD agreement? Would that help lead the way to a better world?

These are the kinds of issues the Panel has grappled with in the present report. We have tried to concentrate on essentials, and to pay particular attention to the pace of change in areas affecting NORAD.

We are impressed by the extraordinary scale and rate of developments in the international political environment. The Paris Summit, the agreement on conventional Armed Forces in Europe (CFE I), German reunification, the transition in Central and

Eastern Europe, and the continuing turmoil and pursuit of new political and economic structures within the Soviet Union were unimaginable only a few years ago.

At the same time, as our analysis shows, there is a disconnection between general political developments and the level of strategic nuclear forces. Even if a START I treaty is signed and implemented in the near future, there are still likely to be over 20,000 nuclear warheads on strategic systems during the next few years and possibly throughout this decade and beyond. And even the speedy negotiation of follow-on agreements on strategic nuclear forces is not likely to reduce capabilities fundamentally in this decade to levels which no longer pose a potential danger to one side or the other. From Canada's own point of view, moreover, the capabilities problem might even be worsening rather than improving, since there is a growing tendency on the part of the two superpowers to increase the numbers of two types of weapons which pose particular difficulties for this country -- long range bombers and cruise missiles.

The question here is whether all this weaponry matters any longer. Some people believe that with the dramatic improvements in East-West relations, all these missiles and bombers are becoming just so many fossils. They argue that Soviet nuclear systems no longer pose any danger to North America, and that consequently joint aerospace defence of this continent is no longer necessary.

The Panel certainly hopes that improvements in the political atmosphere will soon render the old strategic balance obsolete. However, it does not believe that that day has yet arrived. It believes that Canada should do everything possible to make sure that the great stocks of nuclear weapons on the two sides will be properly managed and controlled while work on establishing a new world order proceeds as rapidly as possible, and that this country must continue to play a role, for the time being, in the provision of early warning. The transition to a new order has to be managed as carefully as possible, and the international community has to watch out for upsets and disappointments if they come. Not everything in today's world inspires absolute confidence about the future.

Canada also has a strong national interest in effective surveillance of its vast territories, airspace and waters. This is required for air traffic control, environmental management and other civil purposes as well as early warning, and involves a whole range of systems including ground-based radars, aircraft, communications links and command centres. Space-based surveillance systems may also be deployed sometime in the next century, and these could have multiple uses such as mapping, and verification of arms control agreements, as well as the provision of early warning. At the present time, the cost-effective way of fulfilling Canada's surveillance needs includes joint arrangements with the United States in NORAD.

One way of approaching the question of NORAD renewal is to focus on the pace of change in the political, strategic and technological environment, and then to consider either terminating the agreement or continuing it for a further period so as to help manage the transition to a new era of international security.

A second approach is to conduct a major review of Canadian requirements as well as the changing international scene, and to renew the NORAD agreement for a limited time while this review is in progress.

Canada's own foreign policy objectives must form the basis of any Canadian approaches to discussions with the United States on the question of NORAD renewal or related issues.

Options

The Panel believes that the question of NORAD renewal should be approached by addressing the following sets of options:

a) **The basic question**

Should NORAD be renewed or not?

b) **The time period**

If NORAD is to be renewed, what time period is preferred?:

two years

five years

ten years or indefinitely

c) **The scope of the agreement**

If NORAD is to be renewed, should the agreement be broadened or narrowed? For example, should NORAD's responsibilities be extended in various ways to other aspects of continental defence, such as parts of the maritime defence field? Or should NORAD give up any responsibility for space defence activities, for example, and concentrate solely on air defence?

d) **Canadian initiatives and statements**

If the NORAD agreement is to be renewed, should the renewal be accompanied by Canadian initiatives or statements designed to improve the operations of the accord or to further national goals in continental aerospace defence or related fields? If so, what are they?

Findings

a) **The basic question -- renewal or not**

The world is in the midst of a period of great change, which holds out great hope for the future. However, these processes will take time to work out, and there are still many doubts and uncertainties. Careful management of change is essential, as well as continued commitment to international efforts to uphold and strengthen peace and security. Deterrence is likely to continue as the basic concept guiding US and Soviet strategic doctrines throughout most of this decade and beyond. Canada will continue to be affected by this situation for several more years at least.

Canada plays a vital role in continental defence by helping to provide early warning and thus to ensure the survivability and credibility of United States deterrent forces. Canada also has particular defence concerns of its own in the continuation, and possibly even the growth, of Soviet manned bomber and cruise missile forces. Canada also has particular interests in research and development work on space-based surveillance systems, and in the contributions that NORAD makes to the preservation of this country's own sovereignty.

It is important to look at the NORAD renewal issue in terms of the evolving situation, not as an exercise in standard institutional extension. The Panel has been at pains not to put the cart before the horse.

Taking all these considerations into account, the Panel believes that *NORAD serves Canada well and therefore ought to be renewed for a further period.*

b) **The time period**

2 years -- A two-year renewal would be intended to give time for a far-reaching review of the international situation, for a careful examination of North American aerospace defence requirements for the coming period, and for determining very clearly Canada's needs in relation to aerospace defence and helping to preserve

nuclear deterrence. This would give Canada the opportunity to see whether the United States is truly attentive to legitimate Canadian interests in such fields as consultations on strategic developments, including arms control issues such as long-range bomber and cruise missile limits, before deciding on any further period of renewal. It would also enable examination of the feasibility of complementary multilateral, or circumpolar, aerospace surveillance networks to serve both military and civilian requirements in the future.

Under START, the numbers of Soviet strategic bombers and cruise missiles will likely increase, and this has already generated the requirement for advanced surveillance and interception capabilities. In part because of this, NORAD will remain dependent on Canadian territory for ground-based radar installations for the foreseeable future. The leverage this provides Ottawa could be constructively and judiciously exercised in Washington, both to inform US officials and policy-makers on the potential consequences of strategic arms control agreements for Canada's specific security interests, and to influence US policy in a manner that makes it responsive to Canada's security concerns.

5 years -- The question of a five-year renewal should be linked to the pace of change in continental aerospace developments and general trends in the field of international peace and security. Is the situation likely to remain fundamentally similar in the next half-decade or is the world evolving at such a pace that deterrence, Soviet military power, and much else that we take for granted today will be swept away by a great process of advance into a new era? Will Canada still have a vital interest in North American aerospace defence in five years time? Will the United States?

The argument in favour of a renewal for a period of at least five years is that many of the conditions that have made NORAD necessary in the past are likely to continue without substantial change through 1996, although there may well be considerable change in the second half of the decade.

- Reductions in strategic nuclear weapons under START I will leave large arsenals in place through 1996, while START II is not likely to produce further reductions before 2000. We believe that the air-breathing component of the Soviet force is likely to increase during the next five years, both in numbers and capability.

- Changes in international security likely to result from major developments in political relationships will take some time to work out and will require careful management through a period of transition.

- Factors likely to alter the circumstances after, rather than prior to, 1996 are widespread applications of stealth technology, ballistic missile defence, and the appearance of long-range weapons in non-European states. And space-based radar, able to track aircraft and cruise missiles, which will revolutionize the effectiveness of surveillance for civilian as well as military use, will not be available for considerably more than five years.

10 years or indefinite renewal -- The advantage of a long renewal is that it diminishes uncertainty and disruption, as well as the costs of far-reaching periodic reviews. It enables governments and defence staffs to plan well into the future. Such renewals would *not* mean that Canada was committed to NORAD in perpetuity, without recourse, since allowance for withdrawal after a certain period of notice is already provided for in the Agreement. However, shorter renewals do provide opportunities for reappraisal in light of changing requirements and circumstances, and for this reason the Panel did not support long-term or indefinite renewal.

The Panel's view

As indicated above, all members of the Panel favour renewal of the NORAD agreement. Most favour five years, primarily because they see this as a reasonable length of time for managing the transition in international relations. Another view favours a two-year renewal, to give time for a major review of national requirements and current international developments before considering further extensions of the mandate.

c) **Scope**

The Panel was not convinced of the advantages of trying to broaden the NORAD agreement at this time. Closer links to maritime defence activities, or similar steps, could be pursued effectively at the functional level and without changing the agreement itself.

The Panel also sees little point in trying to narrow the agreement by changing its name and endeavouring to limit its activities to air defence, especially in light of Canada's interest in the possibilities that may be offered by space-based surveillance systems.

d) **Canadian Initiatives and Statements**

As indicated earlier, there are various objectives that Canada should pursue in continental aerospace defence or fields related to it that would not require a change in the NORAD Agreement itself. These include such goals as improved US-Canadian consultations about strategic deployments; Canadian involvement as appropriate in research and development work on space-based surveillance and submarine-launched cruise missile detection and tracking; examination of the feasibility of multilateral surveillance systems; more urgency about controlling manned bombers and cruise missiles through arms control; and the development of greater attention to NORAD and related issues at the political, governmental, parliamentary and public levels.

Accordingly, the Panel believes that, along with a renewal of the NORAD Agreement for a further period, the Government of Canada should set out its views on Canadian requirements in a clear and concise public statement. Also, government and parliament should now begin to work as actively as possible, with their United States' partners where appropriate, to give meaning to their various concerns for international peace and for the security of this country.

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GLOSSARY

ABM	Anti-ballistic missile (system), for interception and destruction of ballistic missiles or their warheads in flight.
ADI	The Air Defence Initiative A US programme initiated in 1985 and continuing today, seeking to develop defences against bomber aircraft and cruise missiles capable of attacking North America.
ALCM	Air-Launched Cruise Missile A missile launched from an aircraft and sustaining itself in flight by the support of aerodynamic lift.
ASAT	Anti-satellite Adjective applied to a system intended to interfere with or destroy satellites.
AWACS	Airborne Warning and Control System Large aircraft equipped with a powerful radar able to detect and track airborne targets at any altitude, and to control friendly aircraft.
BMD	Ballistic Missile Defence
BMEWS	Ballistic Missile Early Warning System A set of large radars located in Alaska, Greenland, and England, able to detect and track ballistic missiles and satellites in trajectories above the Arctic regions.
CFE	Conventional Armed Forces in Europe Negotiations among the members of NATO and the Warsaw Pact to reduce the number of conventional armaments and forces deployed in Europe.
COUNTERFORCE	Targeting of offensive weapons against the weapons (as contrasted to the economic or population assets) of an enemy.
CRISIS STABILITY	A situation in which no member of a confrontation has a logical motive to be the first to resort to violence.
CSCE	Conference on Security and Cooperation in Europe A series of meetings among (now) 34 states dealing with confidence-building, disarmament, human contacts, human rights, and economic relations.

DETERRENCE	A strategy aiming to convince a potential aggressor that, if he were to initiate an aggression, he would suffer losses that would outweigh any potential gains.
DEW	Distant Early Warning The DEW Line was a line of ground-based radars extending along the 70th parallel of latitude from Alaska to Greenland, providing early warning of the approach of aircraft towards North America.
FOL	Forward Operating Location One of the airfields in the Canadian North able to be used by interceptor aircraft on temporary assignment from permanent bases farther south.
ICBM	Inter-continental Ballistic Missile A ground-launched ballistic missile with a range in excess of 5,500 km.
INF	Intermediate-range nuclear forces Nuclear weapons with a range of 500 to 5,000 km. The INF Treaty of 1987 removed all ground-based INF from Europe.
JUSCADS	Joint United States-Canada Air Defence Study
MIRV	Multiple Independently-targeted Reentry Vehicle Reentry vehicles launched by a missile for ultimate flight along separate trajectories towards different targets.
NORAD	North American Aerospace Defence Command The NORAD Agreement between Canada and the United States was established in 1958. The current mandate runs until May 1991.
NWS	North Warning System A chain of ground-based radars extending from Alaska to Northeastern Canada.
OTH	Over-the-Horizon Over-the-Horizon Backscatter radar is a very large ground-based system able to detect and track aircraft at long range and at any altitude.
PAR	Phased Array Radar A type of radar which can scan a large volume of sky and simultaneously track many targets without the need for a moving antenna.

SAC	United States Air Force Strategic Air Command
SALT	Strategic Arms Limitation Talks Negotiations between the USA and the USSR, conducted between 1969 and 1979, seeking to limit both offensive and defensive strategic forces. They produced the SALT I Interim Agreement (limiting offensive weapons), the ABM Treaty (limiting defences against strategic ballistic missiles), and the SALT II Treaty (limiting offensive weapons).
SAM	Surface-to-Air Missile
SBR	Space-based Radar
SDI	Strategic Defence Initiative An ongoing research programme initiated in the USA in 1983. It is attempting to discover methods of defending against ballistic missiles.
SLBM	Sea-Launched Ballistic Missile
SLCM	Sea-Launched Cruise Missile
SSBN	Nuclear-propelled ballistic missile submarine
START	Strategic Arms Reduction Talks Negotiations between the USA and the USSR, initiated in 1982 and still continuing, seeking to reduce the number of offensive strategic weapons.
SAR	Synthetic Aperture Radar (also Search and Rescue)
THROW-WEIGHT	The total weight of reentry vehicles, penetration aids, and associated mechanisms delivered by the propulsive sections of a missile.
USC	US Unified Space Command